REMARKS

Claims 9-13 and 32-43 stand rejected on prior art grounds. The features of previously presented claims 34 and 40 are amended herein into claims 32 and 38. Thus, claims 9-13, 32-33, 35-39 and 41-43 are all the claims presently pending in the application. The Applicants respectfully traverse the rejections of the pending claims based on the following discussion.

I. The Prior Art Rejections

Claims 9-13 stand rejected under 35 U.S.C. 103(a) as being unpatentable over EP 0717435, hereinafter referred to as Eaglesham, singly or with U.S. Patent No. 6,750, 484, hereinafter referred to as Lippert. Claim 11 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Eaglesham in view of Lippert in further view of U.S. Patent No. 5,750,443, hereinafter referred to as Sakamoto and U.S. Patent No. 5, 141,894, hereinafter referred to as Bisaro. Claims 32-43 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Eaglesham, in view of Lippert and Racanelli (U.S. Patent No. 6,410,975), hereinafter referred to as Racanelli.

The Applicants respectfully traverse these rejections based on the following. Regarding the rejection of amended independent claims 9, 32 and 38 and their dependent claims, the Applicants respectfully submit that Office Action does not present a prima facie case of obviousness, pursuant to MPEP§ 2141, because the cited references do not teach or suggest the following features: (1) "wherein said dopant is included at a predetermined peak concentration, and wherein a combination of said size of said doped region and said concentration of said dopant is sufficient to reduce a resistance of said semiconductor layer to less than approximately

4 Kohms/cm^2"(see claims 9 and 32); (2) "wherein said first ion-implanted doped region extends vertically through said semiconductor layer and is aligned above a second ion-implanted doped region in a second semiconductor layer" (see claims 9, 32 and 38, as supported by Figure 14); and (3) wherein said carbon atoms limit outdiffusion of said dopant such that a size of said first ion-implanted doped region within said semiconductor layer is physically limited in order to limit a voltage-to-failure distribution to no greater than approximately 12 volts and no less than approximately 10 volts"(see claim 38, as supported by Figure 4 and paragraph [0050]). Regarding dependent claims 13, 36 and 42, the cited prior art references also do not teach or suggest the feature of "wherein said semiconductor layer is a boron-doped epitaxial semiconductor layer in which boron is introduced only into a central portion of said semiconductor layer during an eptiaxial deposition process and wherein said carbon atoms further maintain said dopant within said central portion of said semiconductor layer."

More particularly, the Office Action states that Eaglesham "teaches a semiconductor layer including for use in bipolar transistor comprising carbon atoms and doped, e.g., ion implanted, dopants such as boron, in the semiconductor layer to form device components, whereby the carbon is incorporated throughout the layer to control diffusion of the ion implanted dopants in the vertical and/or lateral directions within the semiconductor layer. See column 2 line 31 to column 9, line 25. The doped region correspond to the implanted region device region selected wherein the control diffusion in the vertical or lateral diffusion is sought, thus corresponding to the carbon limiting a sizes of the doped region." The Office Action further acknowledges that Eaglesham "lacks the recitation of the dopant quantity to reduce the resistance to less than the specified values" and cites Lippert as inherently disclosing the feature based on

the fact that boron is included in the base of the Lippert transistor at concentration between 5 x 10^{18} and 10^{21} cm^{-3}.

Regarding the feature in amended independent claims 9 and 32 of "wherein said dopant is included at a predetermined peak concentration, and wherein a combination of said size of said doped region and said concentration of said dopant is sufficient to reduce a resistance of said semiconductor layer to less than approximately 4 Kohms/cm^2", the fact that Lippert discloses using a similar range for dopant concentration does not inherently lead to "a resistance of less than approximately 4 Kohms/cm^2." That is, Lippert discloses varying the concentration of dopant across the entire semiconductor layer and/or varying the width of the semiconductor layer between the emitter and the collector to reduce resistance generally. However, as indicated in the specification at paragraph [0012], achieving a resistance of less than 4 Kohms/cm^2 is a function of not only the quantity of the dopant but also the size of the doped region. Therefore, claims 9 and 32 are amended to include the limitation that "a combination of said size of said first ion-implanted doped region and said concentration of said dopant is sufficient to reduce a resistance of said semiconductor layer to less than approximately 4 Kohms/cm^2," rather than the previously claimed feature of "wherein said dopant is included in sufficient quantities to reduce a resistance of said semiconductor layer to less than approximately 4 Kohms/cm^2." Given the structural limitations of Lippert, those skilled in the art will recognize that the desired resistance of less than 4 Kohms/cm^2 may not be achievable by simply varying the width of the base layer or the dopant concentration across the entire length. Therefore, achieving a resistance of less than approximately 4 Kohms/cm^2 by virtue of a combination of a smaller implant region and the dopants at a specified concentration is not inherent in the cited prior art references.

Regarding claims 9, 32 and 13, as amended, these claims further contain the feature of "wherein said first ion-implanted doped region extends vertically through said semiconductor layer and is aligned above a second ion-implanted doped region in a second semiconductor layer." This feature of a first doped region aligned above another doped region in a second semiconductor layer was previously claimed in dependent claims 34 and 40. The Office Action indicated that the alignment of regions would have been conventional and obvious given the teachings in Figure 4 including regions 429, 425, 430 and 432 of Rancanelli. The Applicants respectfully disagree.

Specifically, Figure 4 and column 8, line 22-column 9, line 8 of Rancanelli disclose an thin implanted region 429 that is implanted within a base layer 420 and specifically within the top surface of the extrinsic base region 425 of the base layer 420. Column 3, line 6 to column 4, line 2 provides that the base is a p-type SiGe deposited epitaxially, thus, region 425 is not an ion-implanted doped region. Region 432 is a different type diffusion region positioned laterally relative to the doped region 429. Region 430 is an emitter layer offset from and above the region 429. The doped region 429 is only contained at the top surface of the base layer 420 (see Figure 4) and Figure 1 illustrates that region 429 is not aligned above any other doped region. Therefore, Rancanelli does not teach or suggest the feature of "said first ion-implanted doped region is aligned above a second ion-implanted doped region in a second semiconductor layer." Furthermore, Lippert teaches away from such a structure as Lippert includes carbon in the collector layer below the base layer, specifically, to prevent outdiffusion of dopants from the base layer into the collector layer.

Regarding dependent claims 13, 36, and 42, as amended, these claims contain the feature of "wherein said semiconductor layer is a boron-doped epitaxial semiconductor layer in which boron is introduced only into a central portion of said semiconductor layer during an eptiaxial deposition process and wherein said carbon atoms further maintain said boron within said central portion of said semiconductor layer." Support for this limitation is found within paragraph [0044] and Figure 2 which indicates that "[T]he X axis represents the thickness of the eptiaxial boron doped epitaxial layer 5, 6 as it passes from the silicide layer 4 (Xo) to the wafer 15 (Xt). Therefore, the concentrations of impurities vary from the top to the bottom of the eptiaxial layer 5, 6. ... Boron 21 is in the central region. As discussed above, the carbon 22 helps to keep the boron 21 in a tight physical distribution within the eptiaxial layer 5, 6." No where in Lippert or in any of the other cited prior art references, does it disclose a semiconductor layer that has a central portion doped with boron by eptixay such that it extends laterally through the semiconductor layer and that also has an ion-implanted doped region that extends vertically through the semiconductor layer and is aligned above another doped region in a second semiconductor layer.

Furthermore, while the Office Action indicates that placement of a doped region within the semiconductor layer is simply a matter of design choice that would have been obvious, the Applicants respectfully disagree. The novel placement of the smaller doped region of the semiconductor layer of the invention combined with the concentration of dopant within that smaller region leads to improved results over the prior art (e.g., reduces resistance, decreases the voltage-to-failure distribution, etc.), thereby, making the structure patentable. MPEP§2143.03 requires that all of the claimed limitations must be taught or suggested by the prior art and none

of the prior art references teach the claimed limitations. Furthermore, while the Examiner may rely on knowledge generally available to one of ordinary skill in the art to modify or combine the prior art to arrive at the claimed invention, the Examiner must still present a convincing line of reasoning supporting the rejection (See Ex part Clapp, 227 USPQ 972 (Bd. Pat. App. & Inter. 1985). The statement in Office Action to the effect that "selection of the desired portion of the semiconductor layer including a central portion, to the extent such central region can be determined, would have been a matter of design choice and would have been obvious or encompassed therein" simply disregards the structural limitations within the claims without reason and thus, does not meet the required standard for prima facie obviousness.

Therefore, amended independent claims 9, 32 and 38 are patentable over the cited prior art references. Further, dependent claims 10-13, 33-37 and 39-43 are similarly patentable, not only by virtue of their dependency from a patentable independent claim, but also by virtue of the additional features of the invention they define. Moreover, the Applicants note that all claims are properly supported in the specification and accompanying drawings, and no new matter is being added. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejections.

II. Formal Matters and Conclusion

With respect to the rejections to the claims, the claims have been amended, above, to overcome these rejections. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw the rejections to the claims.

In view of the foregoing, Applicants submit that claims 9-13, 32-33, 35-39 and 41-43, all the claims presently pending in the application, are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary. Please charge any deficiencies and credit any overpayments to Attorney's Deposit Account Number 09-0456.

Respectfully submitted,

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